

526,914

Rec'd PCT/PTO 07 MAR 2005

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date  
4 March 2004 (04.03.2004)

PCT

(10) International Publication Number  
WO 2004/018731 A1

(51) International Patent Classification<sup>7</sup>: C23C 24/08, (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, C25C 3/08, 3/12 AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(21) International Application Number: PCT/IB2003/003654

(22) International Filing Date: 14 August 2003 (14.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: PCT/IB02/03392 20 August 2002 (20.08.2002) IB

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (*for all designated States except US*): MOLTECH INVENT S.A. [LU/LU]; 6, rue Adolphe Fischer, L-1520 Luxembourg (LU).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): NGUYEN, Thinh, T. [CH/CH]; Rte du Grand-Lancy 165b, CH-1213 Onex (CH). DE NORA, Vittorio [IT/BS]; Sandigham House, Nassau (BS).

(74) Agent: CRONIN, Brian; Moltech S.A., Quai du Mont-Blanc 21, CH-1201 Geneva (CH).

**Declaration under Rule 4.17:**

— *of inventorship (Rule 4.17(iv)) for US only*

**Published:**

— *with international search report*  
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

WO 2004/018731 A1

(54) Title: PROTECTION OF METAL-BASED SUBSTRATES WITH HEMATITE-CONTAINING COATINGS

(57) **[Abstract]** A method of forming a dense and crack-free hematite-containing protective layer on a metal-based substrate for use in a high temperature oxidising and/or corrosive environment comprises: (I) applying onto the substrate a mass of particles comprising hematite ( $Fe_2O_3$ ) and: (a) iron metal (Fe) with a weight ratio  $Fe/Fe_2O_3$  of at least 0.3 and preferably below 2, in particular in the range from 0.8 to 1.4; and/or (b) ferrous oxide (FeO) with a weight ratio  $FeO/Fe_2O_3$  of at least 0.35 and preferably below 2.5, in particular in the range from 0.9 to 1.7; and (II) consolidating the applied mass of particles to form the hematite-containing protective layer by heat treating the mass of particles to: 1) sinter the hematite to form a porous sintered hematite matrix; and 2) oxidise into hematite ( $Fe_2O_3$ ) the iron metal (Fe) and the ferrous oxide (FeO) to fill the sintered hematite matrix. The mechanical, electrical and electrochemical properties of the protective layer can be improved by using additives, such as oxides of titanium, zirconium and/or copper. Typically the protected substrate can be used in a cell for the electrowinning of a metal such as aluminium.